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2. (Amended) The method of Claim 1, wherein exposing the insulation layer to the metal precursor comprises:

pulsing the metal precursor over the integrated circuit device; and

exposing the integrated circuit device to an inert gas.

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10. (Amended) The method of Claim 1, wherein exposing the insulation layer to the metal precursor is performed at a temperature of about 100 to 400°C and at a pressure of about 0.1 to 1 torr.

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REMARKS

Applicant appreciates the Examiner's thorough examination of the present application as evidenced by the Office Action of April 1, 2002 (hereinafter "Office Action"). In response, Applicant has amended independent Claim 1 to clarify that the metal oxide layer is formed on a surface portion of the insulation layer that is exposed by upper and lower conductive layers without forming the metal oxide layer on a non-exposed surface portion of the insulation layer. Claims 2 and 10 have been amended to be consistent with the amendments made to Claim 1.

Applicant respectfully submits that the cited references fail to disclose or suggest the recitations of independent Claim 1 as amended. Therefore, Applicant respectfully submits that all pending claims are in condition for allowance. Favorable reconsideration of all pending claims is respectfully requested for at least the reasons discussed hereafter.

Abstract

The abstract is objected to because it is not provided on a separate sheet of paper. In response, Applicant submits herewith a copy of the abstract on a sheet of paper without the title thereon.

Independent Claim 1 is Patentable

Claim 1 stands rejected under 35 U.S.C. §102(e) as being anticipated by U. S. Patent Application Publication No. US 2001/0024387 having Raaijmakers *et al.* as inventors (hereinafter "Raaijmakers") and also as being anticipated by U. S. Patent Application Publication No. US 2001/0006835 having Kim *et al.* as inventors (hereinafter "Kim").

Independent Claim 1 is directed to a method of manufacturing an integrated circuit device in which an insulation layer that comprises oxygen is formed between upper and lower conductive layers. The insulation layer has a first surface portion that is exposed by the upper and lower conductive layers and a second, non-exposed, surface portion. Independent Claim 1 further describes the formation of a first metal oxide layer as follows:

> exposing the insulation layer to a metal precursor that is reactive with oxygen so as to form a first metal oxide layer on the first surface portion of the insulation layer without forming the first metal oxide layer on the second surface portion of the insulation layer.

FIG. 2, for example, illustrates this aspect of the present invention by showing the Al_2O_3 layer **200'** disposed on a portion of the surface of the dielectric layer **110**, but not on other portions of the dielectric layer **110** surface, which are protected by the lower electrode **100** and the upper electrode 120.

Applicant respectfully submits that neither Raaijmakers nor Kim disclose or suggest forming a metal oxide layer on a portion of a surface of an insulation layer that is exposed by a pair of conductive layers without forming the metal oxide layer on a non-exposed surface portion of the insulation layer. Raaijmakers describes supplying a metal-containing reactive species in gaseous form to a bottom electrode surface terminated with a native oxide to form a metal oxide dielectric layer thereon. (Raaijmakers, paragraphs 54 - 56). Raaijmakers further explains that the top electrode is not formed until after formation of the dielectric layer. (Raaijmakers, paragraph 129). Thus, in sharp contrast with the recitations of independent Claim 1, Raaijmakers does not describe forming a metal oxide layer on a surface portion of an

insulation layer surface that is exposed by a pair of conductive layers without forming the metal oxide layer on a non-exposed surface portion of the insulation layer.

Turning next to Kim, as a preliminary matter, Applicant notes that this application has a U. S. filing date of December 19, 2000. The present application claims priority to Korean application no. 00-35708, which was filed June 27, 2000. Thus, the Kim reference can be removed as prior art by perfecting the priority claim through submission of a certified English translation of the Korean application. Applicant has not perfected the priority claim at this time, however, because Applicant submits that independent Claim 1 is patentable over Kim for at least the reasons discussed hereafter.

As discussed above, Claim 1 recites that a first metal oxide layer is formed on a first surface portion of the insulation layer without forming the first metal oxide layer on a second surface portion of the insulation layer. Applicant refers now to the Specification where the text explains that "when an element, such as a layer, region, or substrate, is referred to as being 'on' another element, it can be directly on the other element or intervening elements may also be present." (Specification, page 4, lines 29 - 31). According to Claim 1, the first metal oxide layer is not on the second surface portion of the insulation layer, *i.e.*, the non-exposed surface portion, which means that the first metal oxide layer is not directly on the second surface portion of the insulation layer nor is the first metal oxide layer on the second surface portion of the insulation layer but separated from the second surface portion of the insulation layer by an intervening layer.

The hydrogen barrier layer **140** shown in **FIGS. 1C** and **1D** of Kim, for example, has portions thereof disposed on an upper surface of the second conductive layer **124**. While these portions of the hydrogen barrier layer **140** on the upper surface of the second conductive layer **124** are not "directly on" a non-exposed portion of the dielectric layer **122**, they are nevertheless "on" the non-exposed portion of the dielectric layer **122**, but separated therefrom by the second conductive layer **124**. Thus, in sharp contrast with the recitations of Claim 1, Kim's hydrogen barrier layer **140** is on a non-exposed surface portion of the dielectric layer **122**.

Accordingly, for at least the foregoing reasons, Applicant respectfully submits that independent Claim 1 is patentable over Raaijmakers and Kim, and that dependent Claims 2 - 13 are patentable as depending from an allowable claim.

CONCLUSION

In light of the above amendments and remarks, Applicant respectfully submits that the above-entitled application is now in condition for allowance. Favorable reconsideration of this application, as amended, is respectfully requested. If, in the opinion of the Examiner, a telephonic conference would expedite the examination of this matter, the Examiner is invited to call the undersigned attorney at (919) 854-1400.

It is not believed that an extension of time and/or additional fee(s), including fees for net addition of claims, are required, beyond those that may otherwise be provided for in documents accompanying this paper. In the event, however, that an extension of time is necessary to allow consideration of this paper, such an extension is hereby petitioned under 37 C.F.R. §1.136(a). Any additional fees believed to be due in connection with this paper may be charged to our Deposit Account No. 50-0220.

Respectfully submitted,

D. Scott Moore
Registration No. 42,011

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PATENT TRADEMARK OFFICE

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: BOX NON-FEE AMENDMENT, Commissioner for Patents, Washington, DC 20231, on July 1, 2002.

Traci A. Brown
Date of Signature: July 1, 2002

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Please amend the following claims by adding the language that is underlined ("__") and by deleting the language that is enclosed within brackets ("[ ]"):

1. (Amended) A method of manufacturing an integrated circuit device, [that comprises an insulation layer, the method] comprising:

forming an insulation layer that comprises oxygen between upper and lower conductive layers, the insulation layer having a first surface portion that is exposed by the upper and lower conductive layers and a second, non-exposed, surface portion; and

exposing [at least a portion of an insulation layer that comprises oxygen] the insulation layer to a metal precursor that is reactive with oxygen so as to form a first metal oxide layer on the [at least a portion of the insulation layer] first surface portion of the insulation layer without forming the first metal oxide layer on the second surface portion of the insulation layer.

2. (Amended) The method of Claim 1, wherein exposing the [at least a portion of the] insulation layer [that comprises oxygen] to the metal precursor comprises:

pulsing the metal precursor over the integrated circuit device; and

exposing the integrated circuit device to an inert gas.

10. (Amended) The method of Claim 1, wherein exposing the [at least a portion of the] insulation layer [that comprises oxygen] to the metal precursor is performed at a temperature of about 100 to 400°C and at a pressure of about 0.1 to 1 torr.

Abstract of the Disclosure

Integrated circuit devices are manufactured by exposing at least a portion of an insulation layer that comprises oxygen to a metal precursor that is reactive with oxygen so as to form a metal oxide layer on the portion of the insulation layer. The metal oxide layer may reduce the diffusion of impurities, such as hydrogen, into the insulation layer, which may degrade the electrical characteristics of the insulation layer.